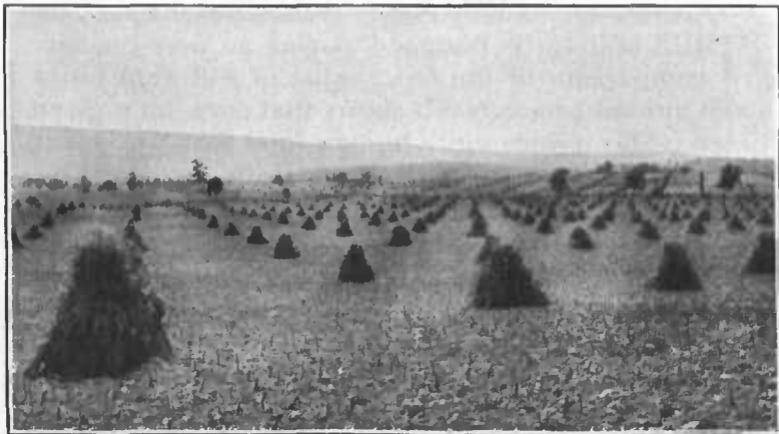


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HUMAN FOOD FROM AN ACRE OF STAPLE FARM PRODUCTS

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THIS bulletin is designed to give an acre-for-acre comparison of the food value of different crops and animal products. It shows that corn, on a given area, will produce more human food than any other crop commonly grown on American farms. This crop heads the list in units of energy produced per acre, and is ahead of all other crops except navy beans and soy beans in tissue-building material. In the latter element soy beans far outclass all other crops, showing nearly twice as much protein per acre as navy beans, which rank second in this regard.

It shows that the dairy cow is the most efficient of farm animals in the production of human food (milk) and that the hog is the most efficient in the conversion of grain into meat, producing five times as much per acre of crops as does any other animal.

The bulletin is not designed as a guide for the planning of farm operations; that is a matter to be determined by local environment, equipment, and general conditions.

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THE present world shortage of food emphasizes as never before the importance, so far as is practicable, of making every acre of land produce a maximum quantity. Increasing the yield per acre by better tillage is a possibility, as is also increasing the acreage of land devoted to crops, and these possibilities should be realized to the fullest extent. Another important means of adding to the supply of human food is by giving increased attention to those crops which produce comparatively large amounts of human food per acre, and to those types of live stock which produce the most nutrient for man from a given quantity of feeding stuffs, always keeping in mind the proper rotation of crops and a well-balanced agriculture. That important additions can be made to the supply of human food in this manner is evident from a consideration of the facts presented in the accompanying table.¹ (See Table I.)

¹ Although the information contained in these pages is too late to have any material effect on this year's production, it should be of value should the war be prolonged into next year. It is published now in order that whatever suggestive value it may have may be available in ample time for next season.

TABLE I.—*A comparison of the food produced annually by an acre of land when utilized in the production of various food crops and live-stock products.*

Food products.	Yield per acre.		Calories per pound.	Pounds protein per acre (digestible).	Calories per acre.
	Bushels.	Pounds.			
Food crops:					
Corn.....	35	1,960	1,594	147.0	3,124,240
Sweet potatoes.....	110	^a 5,940	480	53.5	2,851,200
Irish potatoes.....	100	6,000	318	66.0	1,908,000
Rye.....	20	1,200	1,506	118.8	1,807,200
Wheat.....	20	1,200	1,490	110.4	1,788,000
Rice, unpolished.....	40	1,154	1,460	55.4	1,684,840
Rice, polished.....		1,086	1,456	50.0	1,581,216
Soy beans.....	16	960	1,598	294.7	1,534,000
Peanuts.....	34	524	2,416	126.2	1,265,018
Oats.....	35	^b 784	1,600	89.4	1,254,400
Beans.....	14	840	1,337	157.9	1,123,080
Cowpeas.....	10	600	1,421	116.4	852,600
Buckwheat.....	24	^c 600	1,252	34.5	751,800
Dairy products:					
Milk.....		2,190	325	72.3	711,750
Cheese.....		219	1,950	56.7	427,050
Butterfat.....		98.55	3,605	1.0	355,273
Meat:					
Pork.....	350	273	2,465	22.7	672,945
Mutton.....	205	113	1,215	14.7	137,295
Beef.....	216	125	1,040	18.5	130,000
Poultry: ^d					
Meat.....	103	66	1,045	12.7	68,970
Eggs.....	^{Dozen.} 73.8	^{Pounds.} 110.7	720	14.8	79,704
Total.....				27.5	148,674
For poultry meat alone.....					
	267	171	1,045	33.0	178,695
For eggs alone.....	^{Dozen.} 122.4	^{Pounds.} 183.6	720	24.6	132,192

^a 54 pounds per bushel.

^b Hulled kernels.

^c Flour.

^d The first section under "poultry" assumes that poultry are kept under ordinary poultry-farm conditions, the pullets being raised and the old hens and young males being used for meat. What eggs are not needed for hatching purposes are used for food.

The data for "poultry meat alone" assume the purchase of day-old chicks, which are grown to a 4-pound weight and utilized as food.

The data for "eggs alone" assume the purchase of hens and their utilization for the production of eggs alone.

The first section of Table I, relating to the product of an acre of the leading staple crops grown for human food, needs no explanation further than the statement that the calorie, or unit of heat energy, is the amount of heat required to raise the temperature of 1 kilogram (2.2 pounds) of water 1 centigrade degree ($=1.8$ Fahrenheit degrees). When food is assimilated it undergoes chemical changes in the body which render the energy it contains available for the production of heat and energy. The number of calories produced per acre is a measure of the relative value of the acre product for the production of heat and muscular energy.

The production of live-stock products per acre was arrived at by assuming the acre to be devoted to crops suitable for feeding the kind of animal under consideration and in the proper proportion to give a balanced ration. In cases where it is not practicable to do this because of the necessity of using some feed not produced on the farm, it is assumed that a suitable proportion of the acre product is exchanged for what else is needed.

In the case of hogs, the product of four-fifths of an acre of corn (28 bushels) and one-fifth of an acre of clover are assumed to constitute the feed used. When fed to hogs in this proportion a bushel of corn and the amount of clover consumed with it will make $12\frac{1}{2}$ pounds growth. (See various experiment-station reports.) An acre utilized in this manner will thus produce 350 pounds of increase in live weight in hogs.

In determining the mutton produced on an acre, it was assumed that 0.65 acre of corn, grain (22.75 bushels) and stover, and 0.35 acre of clover (1,050 pounds of clover hay) are fed. A bushel of corn and the accompanying stover and clover hay fed in this proportion to yearling sheep makes, on the average, about 9 pounds of increase in live weight. An acre will thus produce $22.75 \times 9 = 205$ pounds. If the producer uses other feeds than those given in this example he will, of course, calculate their value in terms of corn, stover, clover, etc.

For beef cattle it was assumed that the acre is devoted to feed crops as follows: Corn for grain and stover, 0.80 acre; corn for silage, 0.12 acre; clover hay, 0.08 acre. It was further assumed that one-eighth of the corn thus produced (196 pounds) is exchanged for 146 pounds of cottonseed meal. The above feeding stuffs will feed a good steer 87.7 days a ration consisting of corn 15.64 pounds, cottonseed meal 1.66 pounds, silage 20.5 pounds, clover hay 2.74 pounds, and corn stover 7.29 pounds, allowing for a wastage of two-thirds of the stover as inedible. On such a ration a steer gains on the average about $2\frac{1}{2}$ pounds a day. The entire acre thus produces a gain of 219 pounds live weight.

For the production of dairy products the acre was subdivided as follows: Corn for grain and stover, 0.50 acre; corn for silage, 0.25 acre; clover hay, 0.25 acre. This gives 960 pounds of corn (grain), 1,200 pounds of stover, 750 pounds of clover hay, and 3,760 pounds of silage, which is sufficient to feed a cow giving 6,500 pounds of 4½ per cent milk for 119.2 days, during which time she should give 2,190 pounds of milk.

Ten pounds of milk was assumed to make a pound of cheese. The amount of butterfat in 2,190 pounds of 4 per cent milk is 98.55 pounds. As in the case of beef cattle, there is considerable surplus of stover.

In the case of poultry it was assumed that the ration is made up of corn 34 per cent, wheat 56 per cent, and miscellaneous feeds 10 per cent. One-tenth of the acre was reserved for raising the miscellaneous feeds or products that could be exchanged for them. The remainder of the acre was assumed to be devoted to corn and wheat in proportions suitable for the production of these grains in the proportions stated, or 0.24 acre of corn and 0.66 acre of wheat.

FOOD VALUE OF CROPS.

Corn.—Table I shows that corn heads the list of crops commonly grown in this country. A 35-bushel crop of this cereal produces nearly 150 pounds of protein, or flesh-building material, and more than 3,000,000 units of energy. Wherever the conditions are favorable for extending the acreage of this crop it is evident that considerable addition can be made to the supply of human food by doing so. Millers should give special attention to the preparation of corn meal of good quality, and housewives should use increased quantities of this nutritious and palatable product as a substitute for other bread cereals. It is more practicable to increase the use of corn meal in this country than it is abroad, for our people are familiar with corn as a food, while most European peoples are not. We know how to prepare appetizing dishes from it, while they do not.

The sweet potato.—Sweet potatoes stand second in energy production, but are low in protein produced per acre. The sweet potato is a southern crop, easily produced, but unfortunately a large percentage of the crop is not properly stored and as a consequence large quantities of potatoes are lost every year. However, by building storage houses and handling the potatoes as recommended in Farmers' Bulletin No. 548, the loss can be largely prevented. Growers who have good storage houses keep sweet potatoes throughout the winter for home use or for market. Our Southern States should grow an abundance of this crop, the consumption of which may be made to reduce the demand for bread cereals. Where facilities for canning sweet po-

tatoes are available a portion of the crop preserved in this manner may be made available to parts of the country where the temperature drops so low as to make the shipping of fresh sweet potatoes a precarious undertaking, and the season of their use thus may be extended throughout the year. Sweet potatoes also may be dried successfully, and recent experiments show that meal made of dried sweet potatoes may be used with wheat flour in making bread.

The Irish potato.—The third crop on the list is the common Irish, or white, potato. This crop can be grown in all parts of the country. Its importance does not need emphasis here. During the continuance of the present emergency special effort should be made to produce all the potatoes that are needed.

Rye.—Rye stands next to corn in the list of cereal grains, being slightly more nutritious than wheat, but bread made from rye flour is not so acceptable to the American palate as bread made from wheat flour. It is only on sandy lands, which are better adapted to rye than wheat, and in other situations where rye is known to be a safer crop than wheat, that rye should have preference over wheat as a farm crop intended for human food.

Wheat.—Wheat stands second amongst the bread-making cereals in food produced per acre. Its wide climatic adaptability and the high degree of palatability of its products make it preeminently the bread crop of the world. In sections to which this crop is adapted it should be given precedence over all other crops except corn and potatoes (except on lands better adapted to rye than to wheat), remembering, of course, the necessity of maintaining a well-balanced agriculture.

Rice.—Rice stands very close to wheat in food produced per acre. It is probable that under present conditions a market could be found for a greatly increased output of rice. A considerable saving of valuable food could be made by marketing rice unpolished. The unpolished is much more palatable than the polished grain. If the unpolished rice were generally available, the American people probably would consume considerably larger quantities of this valuable cereal than at present.

The soy bean.—Soy beans lead all other crops in the production of digestible protein, exceeding corn in this respect by almost exactly 100 per cent. This crop deserves more attention in this country than it has yet received. There is no reasonable possibility of overplanting it. Soy-bean meal, the residue after the oil is expressed, can be mixed with wheat flour to the extent of 30 per cent without detriment to the palatability of the product, though the effect of such bread on the digestive tract is not yet known. Dry soy beans now are being used in considerable quantity as a substitute for navy beans in canneries, with excellent results. In addition, the soy

bean is an excellent forage crop for cattle and hogs. Its use for this purpose greatly reduces the necessity for the use of grain and mill products in feeding these animals. The soy bean is a legume recently introduced into this country. It requires inoculation when grown on land new to it. Many farmers have failed in their first attempts to grow this crop because they overlooked this point. It is only a question of time and attention to detail when this difficulty will be entirely overcome. Soy beans, by using suitable varieties for seed, can be grown from southern Michigan to the Gulf coast. The Department of Agriculture will furnish free on application full instructions concerning the culture and management of soy beans. (Farmers' Bulletin No. 372.)

The peanut.—Peanuts are important from the standpoint of human food available from an acre for the reason that, besides being available as a catch crop in corn, they are gaining favor as a staple crop in the sandy lands of the cotton States, especially where the cotton-boll weevil is troublesome. In many sections alternate rows of corn and peanuts give good results, particularly on semiarid lands. In the southeastern States, from Virginia to Florida, peanuts have long been recognized as one of the chief crops for hog raising. The acreage for this and other purposes has increased greatly as hog raising has been introduced in the coastal-plain sections of the southeast.

The demand for peanuts has widened greatly as a result of new methods and the product now enters into two important avenues of commerce—(1) in the form of cake or meal, after the oil is extracted, as a valuable food for live stock, and (2) as a source of valuable fat for use for cooking and other purposes. A larger acreage of this crop is to be encouraged as a means of increasing the amount of pork products in the Southern States and to meet the demand for peanuts for the manufacture of peanut butter and for use in confectioneries. Recent experiments at the Texas experiment station demonstrate methods of feeding peanut meal or peanut cake to avoid the soft flesh in pork which ordinarily results from feeding the raw product. In addition to the nuts the hay is in great demand and it has a feeding value similar to that of alfalfa.

Oats.—Because of the relatively small amount of both protein and energy in oats, it is not believed advisable to increase greatly the acreage devoted to this crop, especially where the land can be devoted to other crops in the list given in Table I (except cowpeas).

The navy bean.—The bean crop is important as a source of protein. The navy bean produces only 36 per cent as much energy but more protein per acre than corn. It can be grown also in regions poorly adapted to corn. There has been a phenomenal increase in the acreage of beans this year, probably greater than conditions

warrant. There is apparently no good reason for further extension of this acreage next year.

Cowpeas.—Although the cowpea crop is unimportant in the present connection, the fact that its seeds are highly palatable to most people and represent an important source of protein, as well as the further fact that it is widely grown in our Southern States as a catch crop in corn or after winter grain, justifies reference to it here. The South devotes its energies so largely to the production of one great money crop, cotton, that any readily available source of human food should not be overlooked in that section. Special effort should be made this year to save all the cowpea seed possible.

Buckwheat.—Buckwheat is important mainly because of the fact that it thrives on very poor land and can be planted very late in the season. The production per acre is large in comparison with that of other crops on poor land.

LIVE-STOCK PRODUCTS.

Table I further shows the amount of human food produced per acre when the land is devoted to the leading types of live-stock farming. The amounts produced are far smaller than in the case of most crop products available for direct use as human food. The justification for the use of land for live-stock farming, even under present emergency conditions, is twofold. In the first place, live-stock products add variety to the diet, and thus conduce to human vitality and efficiency. They contain relatively large numbers of elements which are necessary to the nutrition of the human body and which are found less commonly in vegetable products. Dairy products are especially important in the nutrition of children.

In the second place, many products of the farm are not directly usable as human food, but when fed to farm animals are converted into highly valuable nutritive substances. These products include corn stover, straw, hay, pasture grasses, and numerous waste products found on nearly all farms. Large quantities of by-products of certain manufacturing processes also are used as food for farm animals and thus converted into human food. Oil meal, gluten meal, and sugar-beet pulp are examples.

The necessity for variety in the human diet justifies the use of a certain amount of grain for stock feed, except in the most urgent extremity. Table I shows that the two types of live stock for which feeding grain is most justifiable are dairy cows and swine. An acre of land devoted to the support of either of these two classes of farm animals produces far more human food than is the case with any other class of live stock.

Milk.—Milk heads the list of live-stock products per acre as a source of both protein and energy. The wide range of nutritive sub-

stances contained in milk makes it by far the most important of our animal products. The cost of producing milk often can be lowered by increasing the amount of roughage and decreasing the amount of grain fed to dairy cows. This is especially the case where such roughage as silage, alfalfa, clover, or soy-bean hay is available.

Cheese and butter.—Next to milk and pork, more human food per acre can be produced in the form of cheese or butter than in any other animal product. Especially in those sections where alfalfa is the leading field crop, which is the case in many parts of the West, the production of maximum quantities of cheese and butter is highly desirable under present conditions.

Pork.—The hog is by far the most efficient of domestic animals in converting grain into meat. The product of an acre of land, when fed to hogs, produces five times as much meat as when fed to any other farm animal. Even these animals can be kept with relatively small expenditures of grain by making liberal use of such forage crops as alfalfa, clover, soy beans, rape, and various other kinds of pasture. A great gain also can be made by marketing hogs at lower weights than customary. Gains made below 200 pounds require much less grain than those above this weight. Hogs are also a valuable means of disposing of many kinds of waste on the farm, such as kitchen refuse, skim milk, whey, and defective fruits, vegetables, and grains.

The fact that colored laborers in the cotton fields of the South live largely on corn meal and pork products is of interest. The economic conditions of their existence require the greatest possible economy in food consumption. They have been driven by force of circumstances to subsist mainly on the crop producing the largest amount of human food per acre, and, for the sake of variety in diet, the most efficient food-producing animal available to them.

Other animals.—Table I shows that beef cattle, sheep, and poultry produce comparatively small quantities of human food from a given area of land. Cattle and sheep can be maintained largely on corn-stalks, straw, defective or otherwise cheap hay, waste-land pastures, weeds, and the like. These animals should be kept at least in sufficient quantity to prevent waste of such materials.

Although poultry produce relatively little human food from a given area of land, a small number of fowls can be maintained on farm wastes more largely than is the case with any other farm animal. They consume scraps from the kitchen, waste grain about the feed lots, weed seeds, insects, etc. A sufficient number of them should be kept on every farm to utilize all such materials to the fullest possible extent.

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RELATING TO FOOD PRODUCTION.

AVAILABLE FOR FREE DISTRIBUTION BY THE DEPARTMENT.

- Cereal Breakfast Foods. (Farmers' Bulletin 249.)
Beans. (Farmers' Bulletin 289.)
Potatoes and Other Root Crops as Food. (Farmers' Bulletin 295.)
Food Value of Corn and Corn Products. (Farmers' Bulletin 298.)
Cowpeas. (Farmers' Bulletin 318.)
Sweet Potatoes. (Farmers' Bulletin 324.)
Use of Milk as Food. (Farmers' Bulletin 363.)
Soy Beans. (Farmers' Bulletin 372.)
Mutton and Its Value in the Diet. (Farmer's Bulletin 526.)
How to Grow an Acre of Corn. (Farmers' Bulletin 537.)
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Use of Corn, Kafir, and Cowpeas in the Home. (Farmers' Bulletin 559.)
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Live Stock, 1914, and Census Data. (Separate 656 from Yearbook, 1914.)
Statistics of Grain Crops, 1915. (Separate 682 from Yearbook, 1915.)
Statistics of Crops Other than Grain Crops, 1915. (Separate 683 from Yearbook, 1915.)
Live Stock, 1915, and Miscellaneous Data. (Separate 684 from Yearbook, 1915.)
Statistics of Grain Crops. (Separate 719 from Yearbook, 1916.)
Statistics of Crops Other Than Grain. (Separate 720 from Yearbook, 1916.)
Live Stock, 1916, and Miscellaneous Data. (Separate 721 from Yearbook, 1916.)

FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C.

- Beans, Peas, and Other Legumes as Food. (Farmers' Bulletin 121.) Price, 5 cents.
Principles of Nutrition and Nutritive Value of Food. (Farmers' Bulletin 142.) Price, 5 cents.
Poultry as Food. (Farmers' Bulletin 182.) Price, 5 cents.
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